

Zero Retries issue 0012 2021-10-01

Advanced Amateur Radio - Data Communications; Space; Microwave... the fun stuff!

Nothing great has ever been accomplished without irrational exuberance. [Tom Eyslin](#).

Irrational exuberance is pretty much the business model of Zero Retries. Steve Stroh N8GNJ

The Universal Purpose of Ham Radio is to have fun messing around with radios. Bob Witte K0NR

Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor

In this issue:

- **Exploring the Idea of a Geostationary Amateur Radio Satellite for the Western Hemisphere**
 - **QO-100**
 - **Amateur Radio Geostationary Satellite Project**
 - **ORI's Phase 4 Ground Station and Phase 4 Space**
 - **Experimentation on Commercial Geostationary Satellites is Limited**
 - **Brave? Yes. Experimenters? Maybe.**
 - **Thought Experiment - Amateur Radio Use of FLTSATCOM**
 - **Next Steps**
 - **Tom Clark K3IO - Silent Keyboard**
 - **ZR > BEACON**
 - **ORI Amateur Radio Recognition?**
 - **8 Meter Experimentation?**
 - **The Prescience of Spread Spectrum Scene**
 - **ARDC August 2021 Newsletter**
 - **Request To Send**
 - **Closing The Channel**
-

Exploring the Idea of a Geostationary Amateur Radio Satellite for the Western Hemisphere

By Steve Stroh N8GNJ

Disclaimer 1 - There may be individuals and groups working in private to create an Amateur Radio payload in geostationary orbit covering the Western Hemisphere, but I'm not privy to any such activity.

Disclaimer 2 - What follows are my own wild idea(s) first imagined 2021-04-03 on my blog SuperPacket titled [Thought Experiment - Western Hemisphere Amateur Radio Geosynchronous Satellite](#).

I had hoped to include this article as part of the series New Paradigm Network Amateur Radios that ran from Zero Retries 0007 through Zero Retries 0010 as a logical extension of new radio systems. A geostationary payload for Amateur Radio in the Western Hemisphere would be, to me, the ultimate New Paradigm Network Amateur Radio system.

QO-100

I'm envious of my fellow techie Amateur Radio Operators in the Eastern Hemisphere (and a small portion of Brazil) because they have access to Amateur Radio transponders onboard the Es'hail 2 satellite in geostationary orbit directly above Africa. Those transponders are referred to as Qatar OSCAR 100 (QO-100) - the 100th "satellite" that made it to operational status and was formally declared to be an Orbiting Satellite Carrying Amateur Radio (OSCAR). Because the payload was sponsored by Qatar, it gets to add a prefix to OSCAR-100 - QO-100. See the excellent AMSAT-UK article - [Es'hail 2 / QO-100](#) for more details.

QO-100 is often referred to as a *satellite*. It's not. QO-100 is a hosted payload on a commercial communications satellite. That's an important distinction - Amateur Radio does not have a dedicated satellite in Geostationary Earth Orbit (GEO). Nor, do I think it *could*; those orbit slots are simply too valuable. For a satellite to operate reliably for years at a GEO slot, it must be highly capable and function for years, even decades, including among many other things, it requires sufficient station-keeping fuel to correct its orbit to stay stationary as viewed from Earth (and gracefully move to a parking orbit or de-orbit when its useful lifetime is at an end). The reality is that Amateur Radio simply isn't in that league.

I'm envious because those techie Amateur Radio Operators are having fun [experimenting with homebrewing satellite uplinks](#) to work QO-100, despite being spread over three continents. And often... they're just having fun such as Bill Dzurilla NZ5N discusses in his article [QO-100: Working the First Ham Satellite in Geostationary Orbit](#) in the May/June 2021 issue of ARRL QEX. Unfortunately, \$50/year membership in ARRL is required to read that and most other periodical content published by the ARRL. At the moment I am an ARRL member and I was able to read the article, and operating QO-100 looks like just as much fun as I imagined it would be. In the article there's mention of an interesting hybrid mode - build up your station as transmit-only, and receive via one of several Internet-connected receivers (generically called Web Software Defined Receivers - WebSDRs) such as [the one operated by the British Amateur Television Club \(BATC\)](#). I suppose that's the next best thing to being in the footprint of QO-

100.

With QO-100, Amateur Radio Operators all over the Eastern Hemisphere have a common water hole to gather at in geostationary orbit. With a geostationary satellite, the barriers to entry for satellite communication are much lower because experimenters can spend their time and energy working on the radio systems rather than tracking systems. The more common low earth orbit Amateur Radio satellites have limited availability and are constantly moving across the sky, requiring active antenna tracking systems, and only offer short windows of communication.

Amateur Radio Geostationary Satellite Project

The Western Hemisphere almost had an equivalent to QO-100 - a project begun (I think) in 2015, and discussed in 2016 by Virginia Polytechnic Institute and State University (Virginia Tech) called [Amateur Radio Geostationary Satellite \(ARGS\) / Phase 4B](#). The ~~video~~ [presentation video presentation](#) about ARGS / P4B at the 2016 Digital Communications Conference was exciting! It was an exciting concept and would have been more sophisticated and more capable than QO-100. Unfortunately, the ARGS project / Phase 4B (P4B) project [was suspended](#):

AMSAT / Virginia Tech Geostationary Satellite Project (Phase 4B) Status

Virginia Tech continues to investigate opportunities to fly an amateur payload aboard a geostationary or geosynchronous satellite. A Payload Accommodation Study showed that an amateur payload could be carried on a U. S. Government satellite, but that satellite has been delayed indefinitely. While Virginia Tech was offered a spot on a government satellite, the cost, duration of mission, and lack of guarantees that the payload would be activated resulted in that spot being declined. Discussions continue.

To be fair, it was made clear at every presentation that the ARGS / P4B project was speculative, and depended on the "never quite committed" launch of an experimental satellite.

Sadly, from my reading, there is no (public) activity regarding an Amateur Radio payload in geostationary orbit above the Western Hemisphere. The requirements of Amateur Radio operations are such that a geostationary satellite payload would have to be specifically engineered for Amateur Radio usage, including antennas, because the frequencies that Amateur Radio can use for satellite communications are very different than commonly used for geostationary satellites. The cost of such a unique payload (I'm told) runs to the hundreds of millions of dollars. (The ARGS / Phase 4B project would have been much less expensive because that particular satellite was to be a research satellite rather than a "production" satellite.) Even though Amateur Radio now has Amateur Radio Digital Communications (ARDC) as a [venture fund of sorts](#) for Amateur Radio projects, a dedicated Amateur Radio payload for a geostationary satellite is beyond ARDC's capabilities.

ORI's Phase 4 Ground Station and Phase 4 Space

There was some activity that came out of the ARGS project that is ongoing. [Open Research Institute \(ORI\)](#) was founded, in part, to develop an open source Ground Station reference

design - [Phase 4 Ground Station](#). ORI decided to work on a satellite payload - [Phase 4 Space](#). From my reading, there is no “ready to go” satellite payload currently available from ORI that could be placed on a geostationary satellite opportunity. ORI is certainly working on such a payload, but amateur labor comes with an amateur labor timeline.

Experimentation on Commercial Geostationary Satellites is Limited

I remember reading an editorial (Never Say Die) by Wayne Green, W2NSD/1, editor of the [late, great 73 Magazine](#) proposing the idea that “Amateur Radio” should collectively pay the cost to rent a transponder on a geostationary satellite. (I wish I could find the reference to quote Wayne definitively.) It sounds fun, but in the end it's not that feasible to buy (time on) an existing transponder on an existing geostationary satellite above the Western Hemisphere for Amateur Radio experimentation. No satellite operator wants “amateur experimenters” inexpertly transmitting at their precious geostationary satellites. Operating a geostationary satellite is expensive (there are only so many orbital slots in the Western Hemisphere - precious real estate). Every geostationary satellite is a careful balancing act of juggling multiple antennas (spot beams) and multiple transmitters and receivers. That's why anything that transmits to a geostationary satellite must be installed by a “professional” and there are protections in place to turn off the transmitter remotely to only transmit if authorization is received from the particular transponder to be used. Even if we did do so... to what end? If we want “turnkey” communications amongst ourselves, unlike in Wayne’s day, we now have the Internet.

That said, there is some experimentation going on with receiving data from commercial geostationary satellites. One such project is [Othernet](#) (formerly Outernet). Othernet doesn't involve Amateur Radio, but it is some experimentation with receiving data from geostationary satellites - datacasting. There is a stream of data originating on a satellite transponder that Othernet has bought time on. Othernet has developed their own receiver hardware, and has published enough of the details of its data format to allow reception with other Software Defined Receivers.

Brave? Yes. Experimenters? Maybe.

There is one... *remote*... possibility of Amateur Radio experimentation on an existing geostationary satellite(s) in the Western Hemisphere, and the possibilities of experimentation have already been proven out by brave “experimenters”.

The US Navy's [Fleet Satellite Communications System \(FLTSATCOM\)](#) ([additional article](#)) is a set of remarkably long-lived (launched between 1978 and 1989) geostationary satellites that provide “bent pipe” transponders operating between 240 MHz and 400 MHz. Remarkably, there is no encryption, authentication, or access controls on these transponders. You transmit up to them, they transmit back down. Some of the FLTSATCOM transponders are wideband, supporting whatever mode is transmitted to them - SSB, FM, data, etc.

The US military supplanted FLTSATCOM with the more capable, and presumably more secure [Ultra High Frequency \(UHF\) Follow On \(UFO\) satellite system](#). (Yes, you read that right. Apparently, there are actual “UFO”s in geostationary orbit, and the US military put them there.)

Despite being deprecated by “UFO”, two of the FLTSATCOM satellites are still operational. I'll

guess that the US military is loathe to discontinue any communication system such as FLTSATCOM that's still minimally usable.

FLTSATCOM is so usable, so accessible, that “pirate users” in Brazil (the Brave? Yes. Experimenters? Maybe.) apparently use FLTSATCOM with relative impunity. See the great 2009 article in Wired - [The Great Brazilian Sat-Hack Crackdown](#). Apparently, despite the “crackdown” described in the article, the “Brazilian pirate users” are [still active](#).

Thought Experiment - Amateur Radio Use of FLTSATCOM

If there are (apparently, inevitably) going to be “secondary users” of FLTSATCOM, perhaps it's worth consideration that US Amateur Radio Operators would be better “secondary users” of FLTSATCOM than “Brazilian pirate users”. There's some precedent in such an idea of sharing spectrum and interoperating between US government and US Amateur Radio Operators - the [sharing of the 60 meter \(5 MHz band\) between FEMA and US Amateur Radio Operators](#) and of course, the [Military Auxiliary Radio System \(MARS\)](#). There's also some precedent in the US Military turning over a satellite to Amateur Radio use. In 2017 the US Air Force Academy [transferred control](#) of [FalconSAT-3](#) to Amateur Radio operators (some accounts say control was transferred to AMSAT-NA).

Why *US* Amateur Radio operators? First, the FLTSATCOM satellites were launched, owned, and operated by the US Department of Defense. Second, US Amateur Radio Operators generally respect the rule of law and especially cooperation with US military regarding shared spectrum. One recent example is an [interference issue within the shared military / Amateur Radio 420 - 430 MHz band in New Mexico](#).

One benefit of permitting US Amateur Radio Operators to use FLTSATCOM is that they could act as volunteer “stewards” of FLTSATCOM, monitoring FLTSATCOM and when there are “Brazilian pirate users” operating, “discourage” them from doing so. In return, US Amateur Radio Operators might be permitted to use FLTSATCOM for casual conversations and data communications experiments. For example, I'll guess that VARA FM would work great with FLTSATCOM.

If US Amateur Radio Operators were to be “deputized” to operate on FLTSATCOM, here are some ideas for formalizing the arrangement:

- There would be a (nominal) sponsor organization to provide a clear, direct line of communication between US military and the Amateur Radio participants.
- There would be a formal plan similar to an Federal Communications Commission (FCC) Special Temporary Authority (STA) authorization such as the STA that permitted experimentation with Spread Spectrum in Amateur Radio spectrum in the 1990s. Among other things, such a plan would document the participants, the participant's equipment, and issue regular status reports.
- The only participants would be US Amateur Radio Operators.
- The participants must agree to a code of conduct, including non-commercial use, and strict non-interference to primary user (military) communications.

- The participants must participate in an “out of band” communication system (such as an Internet email distribution list) that could quickly notify them of any change in status of their use of FLTSATCOM.
- Each participant would be required to maintain logs of operation (perhaps online).
- Each participant must participate in regular drills to prove efficacy.
- Each participant must insure that their station hardware operates optimally (no spattering from poorly designed or built transmitters, etc.).

Some benefits that I can imagine:

- Significantly reduce or eliminate the problem of “Brazilian pirate users”.
- Develop "best practices" for an eventual Western Hemisphere geostationary satellite with a wideband transponder such as FLTSATCOM.
- Generate additional excitement for Amateur Radio and especially Amateur Radio satellite activities (and space activities in general).
- Experiment with data modes for a geostationary satellite. For example, a datacasting mode such as Othernet (mentioned above) or even an evolution of RadioMirror.

This was stated as a goal of the ARGS / P4B project:

First Responder Applications:

- Resilient assets allow for 24/7 coverage for amateur radio communications
- Trained operators mobilize to disaster areas to provide emergency communications support
- Support from FEMA and the American Radio Relay League (ARRL)

What was remarkable about this (that I mostly remember from the DCC presentation) was that this was one of the first times that FEMA had expressed any enthusiasm for working with Amateur Radio Operators. I don't remember if it was stated directly, but FEMA is getting stretched pretty thin given the range of disasters it's expected to respond to, and durations. Thus use of FLTSATCOM by widely dispersed Amateur Radio Operators might be a way to extend FEMA's communications capability.

Perhaps the “enthusiasm” expressed by FEMA may extend to the idea of using FLTSATCOM by Amateur Radio Operators.

Next Steps

I've had some time to think about next steps for the idea of use of FLTSATCOM by US Amateur Radio Operators since the original version of this article in 2021-04.

One idea is that Amateur Radio participants in the Military Affiliate Radio System (MARS) would be ideal secondary users of FLTSATCOM. They are disciplined, practiced, and they are registered and vetted to be permitted to use of dedicated MARS frequencies on HF and VHF.

There are also other US military auxiliary organizations and systems such as [US Coast Guard Auxiliary](#) and [Civil Air Patrol](#) that provide emergency communications capability with similar discipline, practice, and public service .

Other than those... I (still) have no idea about next steps. I have no contacts to even explore the feasibility of this idea, even solely within Amateur Radio where this idea would have to be fleshed out much, much better than my thought experiment here. If you have any ideas, please contact me, even if only to suggest who I might talk to.

Leave a comment

Share

Tom Clark K3IO - Silent Keyboard

By Steve Stroh N8GNJ

My intent with Zero Retries is to focus on the near future of Amateur Radio, so there will be few stories like this one, but K3IO's unique contributions to Amateur Radio are exactly what I strive to illustrate in Zero Retries. Thus, it's more than appropriate to eulogize Tom Clark K3IO.

I knew K3IO only by reputation, and met him briefly at Hamvention a few years ago. He kindly explained how the current AMSAT-NA Low Earth Orbit satellites operating as FM repeaters were able to transmit telemetry in-band of the repeater by binary modulation of a subaudible tone - incredibly clever!

I knew of K3IO's considerable influence on the evolution of Amateur Radio satellites, but I had not known of his more fundamental contributions to Amateur Radio digital technology such as the AX.25 specification.

K3IO's life and influence is a stellar testament on just how much of a positive difference one individual can make in the world - if one tries. Rest easy K3IO - we'll take it from here.

ARRL did a [nice story on K3IO](#) - which I'm reprinting in its entirety here.

Past AMSAT President and Director, and Amateur Satellite Pioneer Tom Clark, K3IO, SK

09/30/2021

AMSAT-NA Past President and ham radio satellite and digital pioneer Tom Clark, K3IO (ex-W3IWI), of Columbia, Maryland, died on September 28 after a short illness and hospital stay. An ARRL Life Member, he was 82. Clark's accomplishments are legendary, and he left a lasting footprint in the worlds of amateur radio satellites and digital techniques.

“His long-time technical achievements, mentoring to others, and technical leadership will be missed by his many peers and friends the world over,” said Bob McGwier, N4HY.

To honor Clark, AMSAT has rebranded its upcoming annual gathering as the 2021 AMSAT Dr. Tom Clark, K3IO, Memorial Space Symposium and Annual General Meeting. It will take place on October 30 via Zoom. (AMSAT members may register to attend via AMSAT’s Membership and Event portal.) The event will be livestreamed on AMSAT’s YouTube channel.

A founding member of Tucson Amateur Packet Radio (TAPR), Clark was a co-founder of the TAPR/AMSAT DSP Project, which led to software-defined radio (SDR). He was a leader in the development of the AX.25 packet radio protocol. Clark served as AMSAT’s second President, from 1980 until 1987. He also served on the AMSAT and TAPR Boards.

In concert with McGwier, Clark developed the first amateur Digital Signal Processing (DSP) hardware, including a number of modems. He developed the uplink receivers and the spacecraft LAN (local area network) architecture used on all the Microsats (AMSAT-OSCAR 16, Dove-OSCAR 17, WEBERSAT-OSCAR 18, LUSAT-OSCAR 19, Italy-OSCAR 26, AMRAD-OSCAR 27, and TMSAT-OSCAR 31). McGwier said it was Clark who convinced him in 1985 that the future lay in DSP.

“We started the TAPR/AMSAT DSP [digital signal processing] project, and it was announced in 1987,” McGwier recounted. “We showed in our efforts that small stations with small antennas could bounce signals off the moon, and, using the power of DSP, we could see the signals in our computer displays.” This led to the software-defined transponder (SDX) for satellite work, including ARISSat and AMSAT’s Phase 3E.

Clark received a doctorate in astrogeophysics from the University of Colorado. He went on to serve as Chief of the Astronomy Branch at NASA Marshall Space Flight Center and was a Senior Scientist at NASA Goddard Space Flight Center, where he was principal investigator for the Space Very Long Baseline Interferometry (VLBI) activity there.

In 2005, Clark became the first non-Russian to be awarded a Gold Medal of the Russian Academy of Sciences for his contributions to the international VLBI network. He is a member of the 2001 class of CQ magazine’s Amateur Radio Hall of Fame.

In 2016, ARRL awarded Clark with its President’s Award, to recognize his 60 years of advancing amateur radio technology. On that occasion, McGwier said, “There would be no AMSAT to inspire all of this work without Tom Clark. Tom... saved the organization and inspired all of us to look to the future and aim for the stars.”

Clark was a Fellow of the American Geophysical Union and the International

Leave a comment

Share

Request To Send

Editorial by Steve Stroh N8GNJ

K3IO's eulogy above is a reminder that, in the end, none of us get out of this alive. But like K3IO, we *can* leave the world better for having been here for a little while. K3IO's passing is a reminder that my time is also limited, and that I have projects not yet completed. One big project is to digitize a lot of unique printed material I've accumulated over the decades about Amateur Radio Data Communications. Most of it I haven't seen posted online. One example is that I have the complete run of Packet Radio Magazine (PRM). Few people, especially these days, have ever heard of PRM. Some issues of PRM have been digitized and are available online, but I've not yet seen a complete set of it digitized, so I really ought to do that and get it uploaded to the Internet Archive for posterity. I think that project will be the big "sit at the desk" project for the coming winter season.

Speaking of satellites, Elon Musk [tweeted](#) on 2021-09-16 that [Starlink](#) will be "out of beta" next month. Since he said that in September, that means October. *It's now October. I think that [Starlink is a profound step change in Broadband Internet Access](#)*, and I think that Starlink will also profoundly affect Amateur Radio role in emergency communications. I'll be writing about that perspective in a near future issue of Zero Retries.

Leave a comment

Share

ZR > BEACON

By Steve Stroh N8GNJ

Short mentions of Zero Retries Interesting items.

ORI Amateur Radio Recognition?

On 2021-09-23, Open Research Institute - ORI (@OpenResearchIns) [tweeted](#):
Know someone in open source amateur satellite or terrestrial that deserves recognition? Let us know!

My reply:

The three AR OS projects that wow me every day:

<http://w1hkj.com> (Fldigi)

<https://github.com/wb2osz/direwolf> (Dire Wolf), and

<https://physics.princeton.edu/pulsar/k1jt/wsجتx.html> (WSJT-X)...

Many, many more - good topic to discuss in an article

Despite their organizational name, the only “open” contact method ORI discloses for their organization is Twitter (and two email mailing lists mentioned on their [website](#)). Thus if you have some ideas that you’d like to communicate to them, but aren’t on Twitter, let me know and I can forward them via the Zero Retries Twitter account.

8 Meter Experimentation?

[WL2XUP is an FCC Part 5 Experimental station](#) operated by Lin Holcomb NI4Y, in Georgia operating at up to 400 watts between 40.660 MHz and 40.700 MHz. Cool to see experimentation continuing in Amateur Radio!

The same article as above mentions a 2019 Petition for Rulemaking ([RM-11843](#)) requesting the FCC to create a new 8-meter amateur radio allocation on a secondary basis. Perhaps WL2UXP’s results will “unstick” this petition.

The Prescience of Spread Spectrum Scene

If you want a wonderful example of being way, way ahead of the curve of technology, visit [Spread Spectrum Scene’s web page](#). I remember reading Spread Spectrum Scene back in the 1990s and wow, what optimism he (and we) had back then about the (seemingly) imminent use of Spread Spectrum technology in Amateur Radio.

ARDC August 2021 Newsletter

Speaking of newsletters, ARDC offered a glancing blow about their previous month’s activities in their [August 2021 Newsletter](#).

Leave a comment

Share

Closing The Channel

As of 2021-09-13, Zero Retries is now on Twitter - [@zerorettries](#). I’m not yet *very* active there, but I’ll try to pay attention.

A commenter in Reddit pointed out that I should disclaim that the views I express in about Amateur Radio in Zero Retries are mostly about Amateur Radio in the US. That comment is correct, thus consider it disclaimed that Zero Retries has a US-centric perspective of Amateur Radio. I do my best to think of “rest of world” Amateur Radio in my writing, but I’m not there

in other parts of the world, so if I say something blatantly inaccurate, please call me out.

If you're enjoying Zero Retries, please tell your friends and co-conspirators. For the immediate future, Zero Retries will remain an experiment in progress. Feedback is easy if you're reading Zero Retries in email - just hit Reply and I'll get your email. Or you can go to the web version of any Zero Retries issue, scroll to the bottom, and post a comment on the web version of a Zero Retries issue. I'm especially interested in content ideas about things that you'd like to see discussed in Zero Retries. If you know of "Zero Retries Interesting" projects, groups, activities, etc. please let me know. I do reply to every Zero Retries email I receive.

Email issues of Zero Retries are "instrumented" by [Substack](#) to gather basic statistics about opens, clicking links, etc. There is no "text only, no instrumentation" version of Zero Retries available. I don't use such information in any way other than (in the absence of much feedback) getting some satisfaction that the data shows that people actually do read Zero Retries.

All previous issues of Zero Retries are available without restriction (no paywalls). For some background on Zero Retries, Issue 0000 was The Introduction Issue.

Thanks for reading!

Steve Stroh N8GNJ

Bellingham, Washington, USA

2021-10-01

If you'd like to reuse an article in this issue, for example for club or other newsletters, just ask. Please provide credit for the content to me and any other authors.

Portions Copyright © 2021 by Steven K. Stroh

Below is a much more complete "footer" that has evolved over 30+ issues of ZR.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, here are some pointers:

- **Ham Radio for Dummies** by Ward Silver N0AX is a great overview of Amateur Radio. N0AX is a gifted writer and HRFD is now in its [4th edition](#).
- My two favorite **YouTube** channels for a good overview of Amateur Radio are [AmateurLogic.TV](#). and [Ham Nation](#) (part of Ham Radio Crash Course). These folks just seem to have so much fun!
- [Radio Amateur Training Planning and Activities Committee \(RATPAC\)](#) offers weekly presentations on general Amateur Radio topics (Wednesdays) and emergency communications in Amateur Radio (Thursdays).
- Dan Romanchik KB6NU offers a free **No-Nonsense Study Guide** for the [Technician test](#) (PDF).
- [HamExam.org Amateur Radio Practice Exams](#) offers good **Flash Card and Practice**

Exams.

- When you're ready to take an **Amateur Radio examination** (Tech, General, or Extra), W1MX - The MIT Amateur Radio Society offers [remote exams](#), free for students and youngsters. *There are apparently [many other remote exam options](#).*

Bonus - with an Amateur Radio license, you'll be [more attractive on dates](#) 😊

Closing the Channel

- In its mission to grow Amateur Radio and make it more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex!
- My ongoing Thanks to Tina Stroh KD7WSF for, well, *everything* and Bill Vodall W7NWP as *Zero Retries Instigator in Chief*.
- My ongoing Thanks to pseudostaffers [Dan Romanchik KB6NU](#) and [Jeff Davis KE9V](#) for continuing to spot, and write about “Zero Retries Interesting” type items, on their respective blogs, from Amateur Radio and beyond, that I don't spot on my own.
- [Southgate Amateur Radio News](#) consistently surfaces “Zero Retries Interesting” stories.
- The [Substack email publishing platform](#) makes Zero Retries possible. I recommend it for publishing newsletters.

If you see something interesting mentioned in Zero Retries and would like to search all the Zero Retries “Back Issues”, that's now easy - just click:

Search Zero Retries

If you're reading this issue on the web and you'd like to see Zero Retries in your email Inbox every Friday afternoon, just click:

Subscribe now

If you're a fellow smart person that uses **RSS**, there *is* an **RSS feed for Zero Retries**.

Zero Retries is on Twitter @ZeroRetries - just click:

[Zero Retries on Twitter](#)

Please tell your friends and co-conspirators about Zero Retries - just click:

Share Zero Retries

Offering **feedback or comments** for Zero Retries is equally easy; yes, you guessed it... just

click:

Leave a comment

Email issues of Zero Retries are “instrumented” by [Substack](#) to gather basic statistics about opens, clicking links, etc. I don’t use such information in any way other than seeing that most subscribers actually do read Zero Retries.

All previous issues of Zero Retries are available without restriction (no paywalls). For some background, Zero Retries 0000 was the **Introduction Issue**. Zero Retries 0026 and Zero Retries 0027 were a **2021 Year End Review** of Zero Retries.

More bits from Steve Stroh N8GNJ:

- [SuperPacket blog](#) - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- [N8GNJ blog](#) - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ (He / Him)

These bits were handcrafted in beautiful Bellingham, Washington, USA

If you’d like to reuse an article in this issue, for example for club or other newsletters, just ask. Please provide credit for the content to me and any other authors.

Portions Copyright © 2021-2022 by Steven K. Stroh.

Blanket permission granted for TAPR to use any Steve Stroh content for the TAPR Packet Status Register (PSR) newsletter (I owe them from way back).
